NetFires

Precision Effects for the Objective Force

By Major (Retired) George A. Durham and Colonel (Retired) James E. Cunningham

Secretary of Defense Donald Rumsfeld is on a quest to change the military's culture and thinking about the nation's rapidly changing security environment. The recent actions in Afghanistan speak volumes on the reality of the changes in the Army's operational environment and the benefits of technology to our warfighting capability. Precision munitions have enabled the reduction of forces and logistics because of increased lethality.

The massive bombing raids of World War II involving hundreds of aircraft are now reduced by orders of magnitude in both the number of platforms and number of munitions to achieve even better effects on targets. Each smart bomb delivered on our enemy is more effective than 400 dumb bombs dropped in the past.

This enormous improvement in lethality and reduction in the number of platforms, supporting personnel and logistics is not just the domain of the United States Air Force and Navy. Our Army is moving rapidly on a course of unprecedented change—developing new equipment, revamping tactics and procedures, and revising training and leader development programs—to ensure we can provide the force necessary to support our nation's national defense policy. The Army is exploiting technology to develop the most advanced weaponry possible for the increased lethality, survivability and deployability of the future combat system (FCS)-equipped Objective Force.

The Objective Force may not be organized like the Army today. Basically, the vision for the future Army structure consists of a "unit of employment" (roughly a corps or division) with FCS-equipped "units of action"—the smallest units that can be committed independently. A unit of action can be a combined arms brigade with subordinate combined arms battalions with a number of small units that fight as teams of teams.

The draft Unit of Action Objective Force Organizational and Operational (O&O) concept is of FCS-equipped units that are characterized by tactical speed and mobility, are focused on execution, are scaleable and rely on shaping effects to set the conditions for freedom of maneuver.

NetFires, an indirect fire capability and the focus of this article, will use advanced technologies to provide devastating, continuous close and shaping fires for the Objective Force at the tactical level.

Background. In the 1998 article "Fires: The Cutting Edge for the 21st Century" (May-June), the author, Brigadier General Toney Stricklin, outlined the Field Artillery School's vision for the branch out to 2020 and beyond to serve as a guide for the future. That vision has been updated several times, but the basics remain. Several of the tenets from that vision have enabled the FA to have continued relevance and be within the scope of achieving emerging Objective Force requirements.

HMMWV/NetFires Launcher—Courtesy of Raytheon

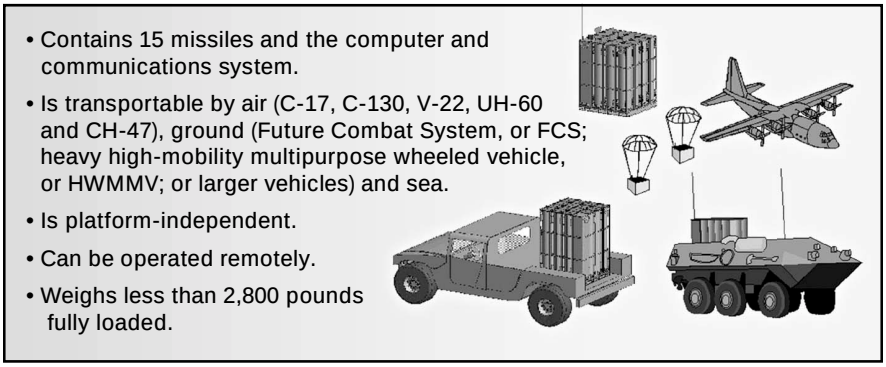


Figure 1: Container/Launch Unit (C/LU)

Among the many concepts proposed in the vision was that of an advanced fire support system that currently is being developed by the Defense Advanced Research Projects Agency (DARPA), Arlington, Virginia. The concept is that of a family of missiles that will be able to attack with precision or loiter over an area before attacking with precision, have a very small logistics footprint and not require a large, heavy, expensive and crew-intensive launch platform.

Lockheed-Martin, Raytheon and Boeing Corporations began to work on this concept in 1998, spending 10 months performing analyses of operational need and technology trade studies and establishing an initial concept definition for the system. The next phase began in 1999 and concluded with a detailed design.

The Depth and Simultaneous Attack (D&SA) Battle Lab at Fort Sill was designated the Training and Doctrine Command (TRADOC) proponent for the system to give DARPA and the contractor teams the information they needed to maintain an operational focus as they developed the critical design parameters and system characteristics.

In August 2000, Lockheed-Martin and Raytheon entered the system fabrication and test phase. They began to harness and integrate new technologies to produce a system with remarkable accuracy, range, lethality and reliability. These technologies include extremely accurate global positioning system (GPS)/inertial navigation system (INS) networked data links, advanced seekers with automatic target recognition (ATR), an advanced pintle motor and miniature turbojet engines.

NetFires System Description. The baseline NetFires system is being designed to attack a full range of stationary and moving targets. It will consist of a container/launch unit (C/LU), computer and communications system (CCS), missile canister (MC), loiter attack missile (LAM), precision attack missile (PAM), NetFires shipping container (NSC) and mission planner computer (MPC).

Container/Launch Unit (C/LU). The C/LU will be the basic NetFires firing unit to serve as both the shipping container and launcher (see Figure 1). The C/LU will be reusable, reconfigurable and contain 15 missiles and the CCS. It will be tamper-resistant and capable of remote commands to conduct firing operations, self and on-command testing for reliability, and self and on-command disabling. A two-man crew will be able to reload and reconfigure the C/LU, to include various mixes of PAM and LAM.

NetFires will be a platform-independent system that does not require a specially designed launch vehicle. Missiles will be fired vertically from the C/LU, either mounted on the vehicle that transports it or from ground emplacement.

Vertical launch will be extremely valuable in built-up areas and forests and from defilade positions. It also will reduce the total mission time because it will eliminate traversing/elevation of the missiles—complicating the enemy's counterfire radar detection of the missiles.

The C/LU will be mountable on robotic and manned ground vehicles or on compatible trailers for drive-on loading into C-130-like and all strategic lift aircraft. No data or electrical power connectors between the C/LU and transporting vehicle will be needed. The concept also envisions parachute or sling loads to deliver the C/LU.

Operators will be able to "ripple fire" both LAM and PAM from the C/LU, at least one missile per second, until all missiles are expended. The operator will be able to send each missile to a different target without physically reaiming the system.

Computer and Communications System (CCS). The CCS will have the required communications and control functions for each NetFires C/LU (see Figure 2). It will consist of a battery power supply, a small ruggedized computer for control of all NetFires system functions, a wireless communications system that is compatible with current and future tactical radio systems, and self-deploying and retracting antenna(s). CCS will be able to provide self-location and orientation data and transfer this information to the missiles, as required. It also will be able to check the system's status periodically or on-demand and perform technical fire direction functions.

The CCS will use standard fire control software to process fire commands originated by maneuver or fire support system sources, using the Army battle command system (ABCS)—the advanced FA tactical data system (AFATDS) and Force XXXI battle command brigade and below (FBCB^2)—and future FCS command, control, communications and computer (C^4) systems.

Missile Canister (MC). The MC will provide the missiles their primary protection against damage in storage, transportation and the tactical environmental. The MC with missiles will weigh no more than about 150 pounds to facilitate quick two-man reloading of the C/LU. The MC will be capable of being stored or transported as part of the C/LU or as a separate unit.

Loiter Attack Missile (LAM). LAM will provide surveillance, targeting, battle damage assessment (BDA), airborne radio retransmission and attack of high-payoff targets (HPTs)—all with the same missile. (See Figure 3.) Using a solid propellant booster, LAM will be

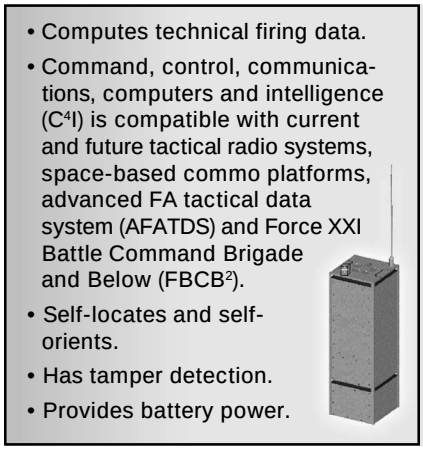


Figure 2: Computer and Communications System (CCS)

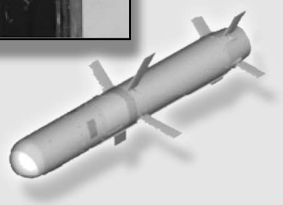
Common Munition Characteristics

- Weight: Approximately 100 Pounds
- Length: Approximately 55 Inches
- Diameter: Seven Inches
- Navigation: Global Positioning System/ Inertial Navigation System (GPS/INS)
- Data Link: Digital, Secure, Reliable and Two-Way

PAM will be launched out of a C/LU and powered by a pintle motor to provide variable thrust. *(Courtesy of Raytheon)*

PAM-Precision Attack Missile

- Range: 5 to 50 Kilometers
- Warhead: Multicapable, Heavy Armor Defeating
- Seeker: Un-cooled Infrared Seeker/Semi-Active Laser (UCIR/SAL)
- Propulsion: Solid Fuel Rocket with Variable Thrust
- Command and Control (C^2): Fire-and-Forget or Man-in-the-Loop Operations with In-Flight Target Updates



LAM-Loitering Attack Missile

- Loiter: 30 Minutes at Greater Than 50 Kilometers
- Warhead: Multicapable, Light Armor Defeating
- Seeker: Laser Radar (LADAR)
- Propulsion: Turbojet Engine
- C^2: Fire-and-Forget or Man-in-Loop Operations with Imagery Transmission to Human Operator and Ability to Send Target Updates to Other Missiles

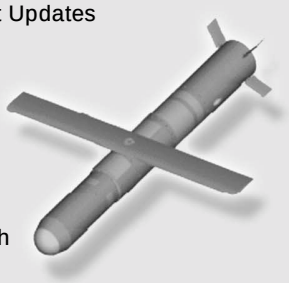


Figure 3: PAM and LAM Capabilities

launched vertically from the C/LU and, powered by a small turbojet engine, fly out to a range of more than 50 kilometers with a loitering time of 30 minutes.

The operator will be able to program mission data patterns into the missile or change the data in flight—to include the LAM's route, targeting priorities, mission tasks (targeting, BDA or attack), attack criteria and search. The missile will have a laser radar (LADAR) seeker with ATR that will be capable of transmitting near real-time information and imagery to a ground station. This control and imagery information will be transmitted over a digital, secure, reliable and networked data link that will support two-way communications between the missile in flight and the ground station. The accuracy with which LADAR will be able to find and identify targets promises affordable precision fires and the reduction of collateral damage.

As an example, if the mission is loiter-attack, LAM will be able to search for specific target types and attack in accordance with instructions that can be programmed into the missile or updated while it is in flight. LAM will have a multi-functional warhead to attack light armored and soft targets, such as BM-21 multiple-rocket launchers (MRLs), command and control (C^2) vehicles, air defense targets, etc.

If the mission is to provide BDA, the LAM will have the "hang time" to transmit post-attack imagery to a ground station to help re-strike decisions.

Precision Attack Missile (PAM). PAM will be launched out of a C/LU and powered by a pintle motor to provide the missile variable thrust. PAM will be a guided missile with many flight profiles. These profiles are bounded by two types: a virtual direct fire trajectory for fast-attack at shorter ranges (0.5 to 20 kilometers) and a boost-glide trajectory for attack of targets at extended ranges (20 to 50 kilometers).

PAM will have a multi-capable warhead effective against armor and soft targets. It will receive target location and description data prior to launch and use a highly jam-resistant GPS/INS-aided internal navigation system to fly to the initial target location. Using the two-way data link, the operator will be able to send target location updates to the missile in flight—especially effective for attacking moving targets.

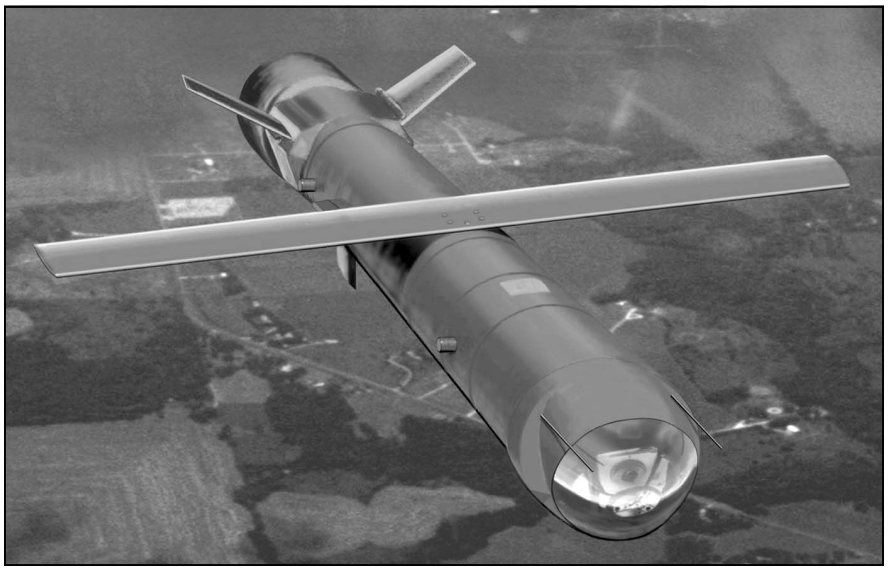
The uncooled infrared (UCIR) seeker will search the target area during the terminal portion of the flight and make final corrections to ensure a high probability of kill. PAM also will have a semi-active laser (SAL) seeker to enable its precision attack. For a description of LAM and PAM capabilities, see Figure 4.

Mission Planner Computer (MPC). The MPC will be the FCS NetFires computer for planning and executing missions in support of the maneuver commander's concept of operations. The MPC will be able to plan and execute LAM and PAM missions simultaneously. In addition, MPC will provide the operator greatly enhanced overall situational awareness and an auto-

Planning Tools

- High-Payoff Target List (HPTL)
- Mission Type: Loiter or Targeting
- Battle Damage Assessment: BDA or At tack
- Weapon-Target Pairing
- Optimal Loiter Attack Missile (LAM) and Precision Attack Missile (PAM) Trajectories
- Flight Altitudes and Routes with Way Points
- Search Patterns
- Seeker and Warhead Selection
- Data Down-Link (Frequency and Secure Codes)
- The Status of Airspace Deconfliction
- Fire Support Coordination
- An ATR Confidence Threshold Report for Autonomous Attack and (or) Imagery Transmission
- Resolution of Terrain Interference Issues
- Recognition of "No-Strike Areas"
- Ability to Avoid Collateral Damage
- An Ability to Check on Communications Line-of-Sight (LOS) and Availability of Communications Relays
- A Method to Control Information Execution Tools
- An Artillery Target Recognition (ATR) Display for Target Selection and Prioritization
- Calls-for-Fire
- LAM Mission Management Display
- Ability to Re-Task a LAM in Flight
- Receive, Record and Show Missile Imagery with ATR Queues
- Allow for Human Interpretation of Missile Imagery
- An Interface with the Command and Control System–the Advanced FA Tactical Data System (AFATDS) or its Successor
- Ensure an Interface between a Forward Observer (FO) with a Semi-Active Laser (SAL) Seeker and the Missile

Figure 4: NetFires Mission Planner Computer (MPC) Automated Tools



LAM in Flight *(Courtesy of Lockheed-Martin)*

mated set of planning and execution tools as listed in Figure 4.

The MPC will be able to display icons over an electronic terrain map, showing the NetFires launch-box locations and, aided by the two-way link, the status of missiles in the air and targets located by LAM. It will allow the operator to select LAMs that are already in flight, interrogate their status and success in finding targets, re-task them onto new routes, and change target lists and ATR confidence thresholds.

The MPC will interface with ABCS, including the all-source analysis system (ASAS), maneuver control system (MCS), AFATDS, air missile defense warning system (AMDWS), tactical airspace integration system (TAIS) and global command and control system-Army (GCCS-A) plus the Air Force's theater battle management core system (TBMCS) and future systems existing at the time of fielding.

NetFires Shipping Container (NSC). NSC will hold up to 10 C/LUs for a total of 150 missiles in an international standards of operation (ISO) shipping container. (See Figure 5.) Its total weight will be less than 35,000 pounds, allowing it to be transported by the palletized loading system (PLS) and heavy expanded-mobility tactical truck (HEMTT). NSC also will be able to be transported by commercial or military wheeled, rail, air and sea systems.

Future Warfighting Concept. The primary mission for NetFires will be to provide the tactical commander ("division" level and below) immediately responsive precision effects on HPTs as well as near real-time target acquisition and BDA. Using NetFires, the warfighter will have expanded capabilities across a broad range of operational situations: continuous close and shaping fires during all phases of early-entry as well as sustained operations.

NetFires' PAM and LAM munitions will attack and be highly lethal against the full spectrum of threat targets. NetFires will be mobile, able to support both contiguous and non-contiguous combat operations, flexible in organization and fully operable with the supported force as well as joint and coalition forces.

Command and Control. NetFires will operate within Objective Force command, control, communications, computers and intelligence (C^4I) systems and architectures. It will operate primarily under the centralized control of an effects coordination cell (ECC) to respond to the needs of the force based on the mission and commander's intent.

NetFires also will be able to operate under decentralized control with combined arms FCS-platform commanders calling for effects. Sensors—such as counterfire radars, unmanned aerial vehicles (UAVs), attack aviation platforms or reconnaissance, surveillance and target acquisition (RSTA) platforms—also will be able to initiate calls for fire.

The amount of centralization will vary based on the mission, enemy, terrain, troops and time available (METT-T) from completely centralized (the ECC planning and executing LAM missions) to totally decentralized (FCS maneuver platforms directly linked to NetFires C/LUs). Despite the degree of decentralization, basic fire support control and coordination procedures will be required to ensure NetFires missiles are delivered according to the commander's intent.

Communications. NetFires will be interoperable with other Army and joint systems. It will be compatible with Objective and Legacy Forces' digitized command, control and communication systems.

The communications to support operations involving NetFires will be a challenge that will demand careful planning and coordination. Each NetFires C/LU and missile will require reliable, uninterrupted and secure connectivity with GPS. NetFires C/LUs could be positioned at distances from the controlling ECC well beyond FM radio operating range, requiring the use of ground, airborne or space communications systems, depending on what is accessible and available.

Targeting. Targeting for the NetFires will follow the standard decide, detect, deliver and assess (D^3A) methodology. The ECC will develop targets based on the high-payoff target list (HPTL) and intelligence collection plan. All available sensors and targeting information will be used to locate targets for scheduled, on-call or immediate attack.

The future AFATDS-like system will match the appropriate munitions with the target in accordance with the commander's guidance. If a NetFires munition is selected, then the system will send the fire mission to the appropriate C/LU.

LAM will provide targeting information in support of the intelligence collection plan or to meet the immediate needs of the commander. It will send

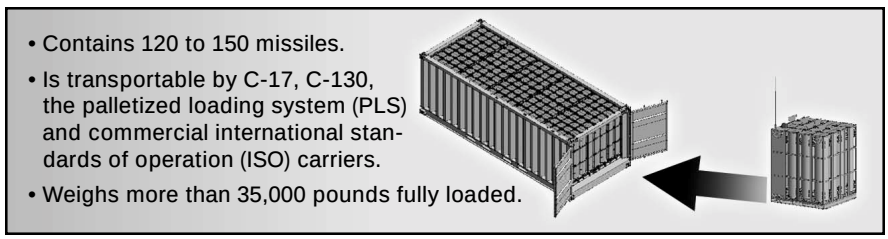


Figure 5: NetFires Shipping Container (NSC)

the targeting and other battlefield information in real time, information that all subscribers on the tactical information network will be able to share.

In most cases, requests for targeting and other LAM missions will be forwarded through fire support coordination channels to the controlling ECC. The ECC then will plan the mission, coordinate fire support and targeting, and execute the mission. Targeting data will be sent to the requester in the form of an artillery target coordinate report, intelligence summary or some other digital or video format. The form of the data will depend on the communications and processing devices at the receiving end.

Logistics. At the tactical level, the logistics system for NetFires units will follow the Objective Force logistics model. Resupply will be accomplished using standard procedures associated with the combined arms unit of action and unit of employment levels of support. When a C/LU has expended all missiles, the owning unit's ammunition section either will replace the expended CL/U or reload the CL/U with missiles, if time permits. The unit's ammunition resupply vehicles will travel to the designated ammunition transfer point (ATP) and draw additional NetFires ammo.

Employment. NetFires will provide precision line-of-sight (LOS), beyond-line-of-sight (BLOS) and non-line-of sight (NLOS) fires plus target acquisition and BDA capabilities. Its primary purpose will be to support the tactical-level maneuver commander with immediately responsive effects to augment existing fire support systems. NetFires will be organic to the maneuver unit of action and supplement the systems in the supporting fires battalion, which will provide close and shaping fires.

The Way Ahead. NetFires has the potential for providing effects that will ensure an overwhelming overmatch to any threat against the FCS-equipped Objective Force. Its advanced technologies are being proven in the DARPA demonstration program. If NetFires' tests continue to be successful, it will be ready for fielding with the first FCS-equipped units in FY10.

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JWES: JMEM Weaponeering on CD

The Joint Munitions Effectiveness Manual (JMEM) Surface-to-Surface Weapon Effectiveness Systems (JWES) CD-ROM is a tri-service (Army, Navy and Marines) tool for weaponeering. The JWES CD-ROM, Version 2.0 to be released in April, is a multi-media product developed by the Surface-to-Surface Working Group of the Joint Technical Coordinating Group for Munitions Effectiveness (JTCG/ME). JWES was developed at the Army Materiel Systems Analysis Activity (AMSAA), Aberdeen Proving Grounds, Maryland.

JWES generates weapons effectiveness estimates of fielded US and threat artillery and mortar systems, US naval gunfire systems and US and threat direct fire systems. It has three major components: the Browse and Weaponeer modules and an Effectiveness Guide. The Browse module provides data and graphics on indirect and direct fire weapons, munitions and targets. It also has information on mission planning, the components of weapons effectiveness, effectiveness models and related JMEMs plus provides a glossary.

The Weaponeer module computes estimates of the effectiveness of indirect or direct fire weapons in various engagement conditions against personnel and material targets. The user can select a range of engagement parameters.

The JWES Effectiveness Guide provides indirect and direct fire effectiveness data in precalculated solutions. For indirect fire, the Effectiveness Guide is similar to standard graphical munitions effects tables (GMETs) and rank orders various selected weapon/shell/fuze combinations against a selected target.

Users can use JWES to compare the effectiveness of many US and threat weapon systems against a wide variety of target types. It is a suitable companion to fielded fire control computers for US FA, mortar and naval gunfire systems. Corps and division tactical operations centers (TOCs) can use JWES for long-range fire planning of multiple assets against high-payoff targets (HPTs).

The 1st Battalion, 20th Field Artillery (1-206 FA), 30th Infantry Brigade (Separate), Arkansas Army National Guard, used JWES for staff planning in its 2000 Battle Command Training Program (BCTP) Warfighter exercise. The brigade fire support element (FSE) used JWES to determine which weapon system and shell-fuze combination would best achieve the effects described in the essential fire support tasks (EFSTs).

Distribution of JWES is restricted to US government organizations and authorized Department of Defense contractors. To obtain a copy of JWES, contact the JTCG/ME Publications Office at Tinker Air Force Base, Oklahoma, by calling (405) 736-5468/2707 or DSN 336-5468/2707 or visit the JTCG/ME home page at *https://jtcg.amsaa.army.mil.*

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